REMARKS

This paper is presented in response to the non-final official action dated August 2, 2010, wherein (a) claims 1-41 were pending, (b) claims 21-40 were withdrawn from consideration, (c) claims 10 and 19 were objected to, (d) claims 9, 12, 14, 17, and 19 were rejected for indefiniteness, (e) claims 1-5 and 7-9 were rejected as being obvious over Nakata, Gay, and Kim, (f) claim 6 was rejected as being obvious over Nakata, Probst, and Menezes, (g) claims 10-17 and 20 were rejected as being obvious over Nakata and Probst, (h) claims 18 and 19 were rejected as being obvious over Nakata, Probst, and Gay, and (i) claim 41 was rejected as being obvious over Nakata, Gay, Kim, and Probst.

By the foregoing, claims 1, 9, 10, 14, 17, and 19 have been amended. Claims 1-20 and 41 remain at issue, with claims 1 and 10 being independent.

Reconsideration of the application, as amended, is solicited.

The issues raised in the official action are addressed below in the order in which they appear in the action.

Claim Objections

Claims 10 and 19 have been amended as kindly suggested by the examiner. Accordingly, reconsideration and withdrawal of the objections to claims 10 and 19 are solicited.

Claim Rejections - 35 USC 112

Claim 9 has been amended to correct erroneous dependency, and thereby supply antecedent basis (in claim 8) for "the high resistance and low resistance layers." Accordingly, reconsideration and withdrawal of the indefiniteness rejection of claim 10 are solicited.

Claims 12, 14, 17, and 19 have been amended to substitute the phrase "in the range of" for the objected-to phrase "in the order of magnitude of." Accordingly, reconsideration and withdrawal of the indefiniteness rejections of claim 12, 14, 17, and 19 are solicited.

Claim Rejections – 35 USC 103

All elected claims have been rejected as being obvious over various combinations of references, all based on Nakata as a primary reference.

As a point of clarification, the action rejects claims 1-5 and 7-9 over Nakata, Gay, and Kim without reference to Probst, but the rejection of claim 6 is based on Nakata and Probst "as applied to claim1 above" and further in view of Menezes. In neither rejection is the disclosure of Probst discussed or even referred to. Therefore, should a further rejection of any of claims 1-9 be based on Probst, such rejection should be non-final in nature.

The various obviousness rejections are respectfully traversed, and reconsideration is requested.

Claims 1-9

The rejection of claims 1- 5 and 7-9 as being obvious over Nakata, Gay, and Kim, and the rejection of claim 6 as being obvious over Nakata, Probst, and Menezes are premised on the assertion that Nakata discloses a semiconductor element with a copper-indium-selenide/sulfur (CIS) layer. However, the action recognizes that Nakata is silent on how the CIS layer is formed.

Gay teaches that a CIS layer may be formed by depositing copper and indium precursor layers and reacting them with H_2Se. The action recognizes that Gay is silent about the pressure used during the selenization process.

The action, however, goes on to state that Kim discloses that selenization may be performed at or below atmospheric pressure.

The action thus concludes that an ordinarily-skilled artisan would arrive at the inventive method (comprising the production of a spherical semiconductor element with a CIS layer obtained by treating Cu and In precursor layer with a hydrogen compound of sulfur or selenium at or below atmospheric pressure) by combining the respective teachings of Nakata, Gay, and Kim.

This conclusion is respectfully traversed for at least the following reasons.

Kim actually teaches only that selenization of precursor layers using selenium vapor may be carried out at or below atmospheric pressure (*see* page 358, point 2, "Experimental Procedure").

However, Kim does ***not*** teach that selenization of precursor layers may be carried out using a hydrogen compound of sulfur or selenium at or below atmospheric pressure, as recited in claim 1.

In fact, Kim does not contain any indication concerning selenization of precursor layers using a hydrogen compound of sulfur or selenium, since the use of H_2Se was explicitly avoided in Kim because due to its toxicity (*see* page 358, point 2, "Experimental Procedure").

The selenization conditions disclosed in Kim, while using selenium vapor, do not provide any indication about selenization conditions required when a hydrogen compound of sulfur or selenium, like H_2Se, is used, as recited in claim 1, since selenium vapor and H_2Se are completely different chemical substances with different chemical reactivities.

Therefore, nothing in the applied references would lead the skilled reader to modify the respective disclosures of those references to arrive at the method recited in the claims. Care should be taken to avoid an impermissible hindsight reasoning based only on information gleaned from the present application when evaluating obviousness. Rather, only the prior art should only be considered when evaluating obviousness.

Doing so, one must note that there is absolutely no indication or hint concerning the pressure used for selenization with a hydrogen compound of sulfur or selenium, like H_2Se, in the prior art represented by Nakata, Gay, and Kim.

Therefore, the ordinarily-skilled artisan, starting only from the applied art and without gleaning information from the present application would arrive at the idea of performing selenization of copper and indium precursor layers with a hydrogen compound of sulfur or selenium at or below atmospheric pressure to obtain a spherical semiconductor element with a CIS layer, since there is simply no indication to do so in the prior art.

Claim 1, as amended, recites that the substrate core comprises soda-lime glass. Claim 2 recites that the conductive back contact layer is molybdenum. The combination of a conductive back layer (preferably molybdenum) with a soda-lime glass core further differentiates the invention of claims 1-9 from the prior art (see the discussion regarding claims 10-20 and 41, below).

Accordingly, claims 1-9 are not obvious over the applied art, and withdrawal of the rejections and allowance of claims 1-9 are solicited.

Claims 10-20 and 41

The rejections of claims 10-20 and 41are respectfully traversed, and reconsideration is solicited.

The action states that Nakata discloses a spherical semiconductor element with a CIS layer. However, the action recognizes that Nakata is silent about a glass substrate and a molybdenum back contact.

The action asserts that Probst discloses a conventional plane solar cell with a glass substrate and a molybdenum back contact, and goes to to conclude that it was obvious to arrive at the invention by combining Nakata and Probst.

Nakata discloses a spherical solar cell with a metal core (21), an aluminum coating layer (22), silicon layers (23, 24 and 25), an SiO_2 layer (26), a TiO_2 layer (27), electrodes (28), and a junction protective layer (29).

Nakata thereby discloses in only one very general sentence that the aluminum coating can be eliminated and that other semiconductor materials used in known solar cells, such as $CuInSe_2$, can be used to construct the electricity generating layer.

Nakata is silent about the use of a glass substrate or a molybdenum back contact.

Probst, on the other hand, discloses a flat a conventional planar solar cell with a glass substrate and a molybdenum back contact.

However, Probst also discloses that especially when glass substrates are used, problems may arise with contaminants deriving from the substrate, which may cause a dependency of the solar cell properties (*see* column 1, lines 33 to 67 and column 2, lines 1 to 3).

In addition, Probst also discloses that chalcopyrite layers often have poor adhesion on the molybdenum back contact (*see* column 2, lines 4 to 6).

In the light of the actual disclosure of Probst, the question is thus whether it was obvious for one skilled in the art to replace the metal (or alloy) core of Nakata by a glass core and to use a molybdenum back contact for spherical solar cell as stated by the examiner.

Care should be taken in this case to avoid impermissible hindsight reasoning based only on information gleaned from the present application when evaluating

obviousness. Rather, only the prior art should only be considered when evaluating obviousness.

Doing so, one must note that there is absolutely no showing or suggestion toward replacing the metal (or alloy) core of Nakata by a glass core or toward the use a molybdenum back contact for a spherical solar cell, as recited in claims 1-20 and 41..

To the contrary, Probst leads away from replacing the metal (alloy) core of Nakata with a glass core and from using a molybdenum back contact for a spherical solar cell.

In fact, Probst explicitly discloses that using glass substrates may lead to problems, especially in combination with chalcopyrite layers, such as for example $CuInSe_2$ (see column 1, lines 33 to 67 and column 2, lines 1 to 3). Probst proposes to use a barrier layer for planar conventional solar cells to lower the diffusion of alkali metal and alkaline earth metal ions, which are cited as particular examples of contaminants accompanying the use of glass as substrate. This may allow reduction in such diffusion effects and improvement in the properties of the cells.

An ordinarily-skilled artisan would conclude from Probst that a glass substrate may lead to problems because of contaminants and diffusion of certain compounds, and would thereby surely avoid the use of such substrates when considering a modification of Nakata (particularly when contemplating using small spheres as substrates), since when using small glass spheres as a substrate, the contact surface between the glass and layers applied thereon is much larger compared to the contact surface obtained when using a massive glass pane as substrate. The surface of all the small spheres used for covering a given surface is thereby actually much larger compared to the surface of a flat glass pane of the same size.

Starting from the prior art at the time on filing and without gleaning information from the present invention, an ordinarily-skilled artisan would thus surely and expressly avoid the use of a glass substrate when contemplating using small spheres as substrate, since the large contact surface of the spheres would increase the problems arising from contaminants or diffusion coming from the substrate.

Moreover, even if Probst may address a special issue related to one particular type of contaminants (alkali metal and alkaline earth metal ions) accompanying the

use of flat glass panes as substrate, there is no indication in the prior art and especially in Probst that a barrier layer according to Probst may eliminate all the negative effects related to the use of glass as substrate, since other contaminants may of course also be relevant.

This is again especially true when small spheres are used as substrates because of the significant increase of contact surface between the small spheres and layers applied thereon.

Actually, in this later case even minor contaminants, which may not be so important when a flat glass pane substrate is considered, may become highly relevant because of the huge increase of contact surface between the small spheres and layers applied thereon. Any conclusion concerning a possible use of small glass spheres together with a barrier layer as proposed in Probst would thus only be pure speculation with no prior art basis.

Therefore, even if Probst may address a special issue related to one particular type of contaminants (alkali metal and alkaline earth metal ions) accompanying the use of flat glass panes as a substrate, the entire teaching of Probst explicitly leads away from using glass as a substrate, because it was known (at least from Probst) that using glass as a substrate may cause a dependency/variation of the solar cell properties and may lead especially to problems arising from contaminants deriving from the glass substrate (among which alkali metal and alkaline earth metal ions are only particular examples) . In addition, this is especially true once the use of small glass spheres as substrate is considered.

One skilled in the art would therefore not simply modify Nakata, which teaches the use of small spheres as substrate, by using a glass substrate in view of Probst.

Rather, based only on the prior art at the time of filing (without gleaning any information from the present invention) and especially considering Probst, one would even expressly avoid to use a glass substrate.

Probst accordingly explicitly leads away from the present invention.

Moreover, Probst also explicitly discloses that chalcopyrite layers have poor adhesion on the molybdenum back contact (see column 2, lines 4 to 6).

A person skilled in the art knowing from Probst that chalcopyrite layers have only poor adhesion on the molybdenum back contact, would thereby surely avoid the use of such a back contact layer when considering a modification of Nakata (especially when contemplating using small spheres as substrates), since when using small glass spheres a substrates the high curvature of the glass spheres and the tensions induced thereby in the layers applied thereon would only worsen adhesion problems. The surface curvature of small spheres and the tensions induced thereby in the layers applied thereon is not comparable with a system using a flat glass pane as substrate.

Starting from the prior art at the time on filing and without gleaning information from the present invention, a person skilled in the art would thus surely avoid the use of a molybdenum back contact when contemplating using small spheres as substrate, since the high curvature of the spheres would even increase adhesion problems.

One skilled in the art would therefore not simply modify Nakata, which teaches the use of small spheres as substrate, by using a molybdenum back contact as disclosed in Probst.

Rather, based only on the prior art at the time of filing (without gleaning any information from the present invention) and especially considering Probst, one would even expressly avoid to use a using a molybdenum back contact.

Probst accordingly explicitly lead away from the present invention.

It does therefore not appear how someone skilled in the art starting only from the prior art at the time of filing and without gleaning information from the present invention would come up with the idea of modifying Nakata, which teaches the use of small spheres as substrate, by using a glass substrate and/or using a molybdenum back contact.

The fact that a glass substrate and a molybdenum back contact may be used even with small spheres as substrates has thus to be considered as surprising in view of the prior art. This could not be expected based only on the prior art.

Claims 10-20 and 41 therefore must be considered inventive compared to the prior art, and withdrawal of the rejections and allowance of claims 1-20 and 41 are therefore solicited.

Conclusion

For all the foregoing reasons, claims 1-20 and 41 are of proper form and scope for allowance, and such action is solicited.

Should the examiner wish to discuss the foregoing or any matter of form in an effort to advance this application toward allowance, she is urged to telephone the undersigned at the indicated number.

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Respectfully submitted,

By_____

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